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IIT Research Institute
10 West 35 Street, Chicago, Illinois 60616
312/567-4000

H6056

December 4, 1978

National Aeronautics & Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Attention: Mr. James H. Ehl, Chief
Tooling Applications Branch
Materials and Processes Laboratory (EH44)

Subject: Manufacturing Process Applications Team (MATEam)
Contract No. NAS8-32229
Quarterly Status Report No. 3
Covering the Period August 1, through October 31, 1978

Gentlemen:

INTRODUCTION

This is the third quarterly report for the 1978 MATEam program. During the past three months team activity has been concentrated on promotion of Joint Industry/Federal Agency/NASA funded R.T.O.P. programs. In addition team effort continues to be applied to direct transfers and improved team publicity. During the reporting period a total of four (4) direct technology transfers have occurred and RTOP funding approvals in two technology areas have been obtained.

Direct transfers have occurred in cutting tools, laser wire stripping soldering and portable x-ray unit technology.

R.T.O.P. program funding approval has been obtained for the further development of the cutting tool Sialon and development of an automated non-destructive fracture toughness testing system.

The publicity of the MATEam has been improved with presentations at high visibility technical meetings, NASA equipment demonstrations, and better use of the technical news media.

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TECHNICAL PROGRESS

Research and Technology Objectives and Plans (RTOP) Activities

MATeam RTOP promotion was concentrated during the reporting period in the cermet cutting tool Sialon and automation of the non-destructive fracture toughness test.

The direct transfer of the Sialon cutting tool (JPL) has resulted in the need for additional sample material and machine shop experience indicates that additional development is required relating to improving the grindability of the material. New cutting tool designs required for additional field tests have been forwarded to JPL who are planning on making the new tool bits. An RTOP has been approved for the JPL activity for an estimated value of \$10,000.

The RTOP "Automation of Fracture Toughness Measurement by Ultrasonics" (Lewis) has been approved for an estimated \$100,000. As discussed in the second MATeam quarterly report the Sun Shipbuilding and Dry Dock Company have expressed a strong interest in the process and joint participation. The MATeam will continue to interact with the Lewis Field Center and Sun to promote a joint funded program.

New potential RTOP programs presently being concentrated on include the Laser Wire Insulation Stripping System, the Recycling of Paint Process Wash Water (Kent Problem), and the In-Process Laser Technique for Balancing Drive Shafts. An up-to-date status of the Team's activities in these and other areas is described below..

MAT-16 - Waste Heat Recovered from Stack Gas or Waste Water

The Polyester Fabric Mill of Burlington Industries presently uses NASA heat pipe technology in the nylon drying system; the device is manufactured by Isometrics Inc. The system allows for a more efficient use of heat, but is plagued with fowling of heat transfer surfaces. If NASA technology can be identified as a solution to the fowling problem, a jointly funded applications program between Isometrics, Burlington, and NASA will be considered.

Burlington has created a new concept in fabric drying techniques using fluidized bed technology. Burlington feels the concept has the potential to revolutionize fabric drying which is a high cost area in

the textile industry. They are having problems in finalizing the concept and are interested in potential NASA problem solving technology.

MAT-19 - Power Factor Control System

MATeam effort during the reporting period was devoted to promotion of Emerson Electric Company and Electrical Relays Inc. participation in the development program defined in the recently released RFP Program. Promotion of program participation continues, however, there is doubt that Emerson will participate since they are deeply involved in internal programs.

MAT-54 - The Non-Destructive Testing of Spot Welds

General Motors Technical Center at Warren, Mich. was contacted regarding several non-destructive testing processes developed by NASA in addition to the portable spot weld test device. Technology pertaining to the ultrasonic spot weld test device, and the fracture toughness ultrasonic device has stimulated considerable interest and the technical center personnel are presently evaluating the technical data provided.

MAT-71 - Computer Aided Design for Sand Casting Molds

The use of computer programs to aid in the design of sand casting molds is a technology that has stimulated significant interest in the aircraft and foundry industry. The use of the NASA computer programs (Tech Brief B72-10736 and MSC-13805) will improve casting quality and cost savings which will be realized in reduced scrap rates. MATeam has made contact with the Dept. of Defense, General Motors and Chrysler, interest is high; however, there has been no strong indication of the nature of a technology transfer at this time.

MAT-82 - Automatic Laser Inspection of Printed Circuit Boards

Raytheon of Bedford Mass. has expressed strong interest in the NASA device and has been forwarded the Chrysler (Huntsville, Ala.) report which details the up-to-date status of the laser scanner development. Chrysler is presently developing the device for examination of printed circuit boards on automobiles during manufacture. Chrysler has entered into an agreement with T.A.I. Corp. to produce the device for their own use and sale to the open market.

MAT-86 - The Weld Skate

A total of 7 companies have been sent the RFP package. The companies, Miller Electric, Hobart, Lincoln, Cecil Equipment, Arcair, Merrick, Linde, are a strong representation of the welding equipment industry. The MATeam has assisted in preparation of the list and has promoted company participation in the program. At the writing of this report two (2) companies have responded. The reduced participation may be caused by an excellent market which presently exists for conventional welding equipment.

MAT-87 - Low Intensity Portable X-Ray Device (LIXI Scope)

Ni-Tech, Inc. obtained a non-exclusive patent license and plans to manufacture and market the scope. Management is presently planning market strategy. Concerns have been expressed relating to the radiation level of the device since medical personnel are exposed to the low level radiation when using the device.

MAT-105 - In-Process Laser Technique for Balancing Drive Shafts

A market study has been completed on the laser balancing system and results indicate that the level of uniqueness is marginal for the NASA device. The major difference in the NASA balancing device over others available is that the laser vaporization is done while the shaft is rotating, other commercially available devices just mark the area of out-of-balance; the area is then machined. MATeam will continue communications with major users and marketing organizations to determine if the NASA technique has a significant advantage.

MAT-131 - Reliable, Economical, Fast Manipulator Arms

After considerable search and effort by MSFC personnel, Jim Wiggins and other MATEam members, the drawings for the manipulator arm have been located. Copies of key assembly drawings are being reproduced and will be forwarded to Unimation Inc. and Vim Mfg. (Robot manufacturers) for their review and comment.

A technical support package is being prepared by H. Holley (Ames) pertaining to the computerized robot developed for the Ames Field Center by Stanford Research Institute. The package will be reviewed by key robot manufacturers. The Maritime Administration continues to be interested in a joint funded development program using NASA technology which will result in a device capable of performing underwater duties.

MAT-167 - The Recycling of Painting Process Wash Water for Industrial Applications and Ecological Compatibility

The MATEam, working closely with the IITRI Chemistry Division, has identified NASA Technology in the form of an improved membrane (B72-10710-Ames Field Center) for the reverse osmosis filtration of process water. The membrane is not available on commercially available systems. IITRI chemists conclude that a system utilizing the NASA membrane will solve the ecological problem concern for discharge and reuse of painting process wash water.

Kent Corporation management has expressed an interest in a joint funded development program that will result in a new generation reverse osmosis device that may be used in the plant. MSFC personnel are presently evaluating its RTOP potential.

MAT-168 - Orbital Tube Flaring Device

MATEam continues to search for qualification test data used to verify the effectiveness of the flaring device. A demonstration of the device is being planned for February at the Marshall Space Flight Center (MSFC).

MAT-175 - The Removal of Wire Insulation Using Laser Techniques

On July 18 a demonstration of the insulation stripping system was conducted at the Rockwell International Facility at Downey, Calif. Thirty attendees representing 15 industry and federal agency organizations showed interest in the device as a direct transfer and in scaling up the system for application to large cable in the scrap industry. The Raytheon Company is interested in obtaining the system as designed for electronic applications. Others with similar interests include McDonnell-Douglas and Westinghouse. The scrap industry including the Department of Defense and the Southern Foundry Div. of SMC Corp. are interested in scaling up the system for large cable. The MATEam will pursue clarification of the Martin Marietta patent and will pursue transfer of the technology to the interested parties.

Direct Technology Transfers

The cutting tool Sialon (MAT-117) was transferred to the Accurate Tool and Manufacturing Company. Accurate, a major machine shop in the Chicago area evaluated sample Sialon cutting tools provided by MATEam. The tools were used for rough turning operations and performed better than other commercially available cutting tools. Cracking problems were encountered when regrinding the tools. Special care is required when grinding, details on the proper grinding techniques have been provided by JPL. As referenced earlier in the report, additional cutting tools are presently being made by Jet Propulsion Lab and will be disseminated to other machine shops and potential marketing sources.

NASA soldering technology (SP-5064) in the form of an improved solder reservoir joint design has been employed in the solder joint of a pressure sensor. The sensor includes an austenitic stainless steel diaphragm which is soldered to a metallized aluminum oxide refractory wafer to form a leak tight cell. The overall system regulates the gas to air mixture when the diaphragm flexes as a result of variations in atmospheric pressure, which improves carburetor economy. All other information pertaining to the device is proprietary - the developer is the Bunker Ramo Corp.

NASA Laser Wire Insulation Stripping Technology (MAT-175 - TSP-SP-5107) developed at Rockwell International has been reviewed by the Raytheon Company (Bedford, Mass.) and they have extracted design concepts used in the NASA designed Rockwell laser stripper devices built at Raytheon and are presently using these concepts.

The fourth technology area in which a direct transfer has occurred is the hand held Lixiscope x-ray device. Ni-Tech Inc. has obtained a non-exclusive license to manufacture and market the portable system. Modifications to design and market plans are in process.

Progress related to other direct and potential transfers is discussed below.

MAT-59 - High Quality Nickel Powder

Technology has been sent to industries and associations involved in powder metallurgy. The In-Plant Powder Metallurgy Association, and The Metal Powder Industries Federation have asked for additional NASA technology for a possible publication in their trade journals. The AirResearch Manufacturing Company in Phoenix is presently reviewing NASA technology related to new NASA nickel base super alloys developed at Lewis Field Center.

NASA (Tech Briefs 66-10606, 69-10293, 70-10331, 70-10468, 72-10344) has shown a series of high quality nickel base alloy powders that have been produced using atomizing techniques and prealloyed powder. NASA test results have shown that the elevated temperature tensile strength properties of parts made from the powder are 1.5 to 2 times better than cast properties. In addition, the alloy has shown improved ductility at elevated temperature.

The major benefit in the availability of powdered parts is the cost saving obtained in the machining operation and the ability to produce a part with more closely controlled properties.

Discussions with the Lewis Field Center personnel has revealed that techniques have been developed for the processing of low oxide level high purity alloy powders. Contacts will be made with the major aircraft turbine manufacturers to measure the uniqueness of the low oxide quality level technology.

MAT-80 - Improved Flux in Stud Welding of Aluminum (AQUET)

Due to the limited market size for the flux, there has been no manufacturer or marketing source located during the reporting period. MATEam has communicated with Omark Industries KSM Stud Welding Div. and Coordinated Industries of Pittsburgh and there has been no interest expressed. Contacts with smaller marketing organizations is in progress.

Discussions are presently in progress with the minority company, Quinco Manufacturing Company of Chicago.

It is anticipated that a marketing source will be selected during the last reporting period.

MAT-183 - Temperature Measurement Using Telemetry

Two NASA-developed miniature telemetry system wiring diagrams have been forwarded to a textile manufacturer for remote temperature measurement in continuous drying ovens used for textile sheet. The systems have been evaluated by the respective R&D staffs. The high frequency systems were evaluated in the present drying ovens and due to shielding effects did not function effectively. A second system for low frequency signal operation has been forwarded.

Market Study Activities for Potential RTOP Programs

In order to provide a firm basis for guidance in the planning and funding of RTOP programs that are an outgrowth of a problem/opportunity, a new technology evaluation report and a preliminary market survey is performed. Both tasks are performed by the IITRI Technology Transfer and Market Research Section. The report substantiates the uniqueness of the technology involved and the survey provides a preliminary insight into its market potential. Enclosure (1) is a list of the new technology evaluation reports and market surveys performed since the start of the program and those presently in progress.

The new technology report and market survey activity is initiated by the MATEam when sufficient interest in a potential joint funded application program is expressed by the industrial source.

Industry Contacts

The MATEam continues to expand and strengthen its communications to industry with presentations given to selected industrial societies

and companies. Industry continues to show interest in the program; however, there continues to be a significant amount of companies and industries that are not aware of the MATEam program.

During the reporting period there was a total of 82 new company contacts. A total of 14 new problem/opportunity statements have been added to the present active list. The active list at present totals 111 in number. A summary of MATEam activities expressed in problem statement assessment and RTOP support activity is contained in enclosure (2).

There was a total of three presentations given during the three-month period to key industrial organizations. They include the Department of Defense MTAG Meeting, the Marine Transport Industry Conference, and the Tool and Die Institute Meeting as listed in enclosure (3).

The Department of Defense (MTAG) meeting at San Diego, California provided a strong benefit to the MATEam in that it provided an opportunity to present the goals and activities of the Team to other military and federal agencies. Secondly, it enabled identification of the manufacturing problem areas of concern to the other agencies and the individuals involved. It is anticipated that additional problem statements will result from the meeting and improved interaction between the MATEam and the Department of Defense in the coming year.

The Marine Transport Industry Conference at Williamsburg, VA. themed, "The Transfer of Aerospace Technology to the Transport Industry", was of equal importance to the MATEam, if not to a greater extent. The meeting enabled a discussion of the transport industries' problems with selected representatives from the aerospace industry.

During the three-day session several problems were discussed in which there is known NASA technology that may be a potential problem solution. Similar to the MTAG meeting, the conference afforded the chance to present the objectives of the MATEam to the transport industry. In addition Key organizations and individuals within the industry were identified that will be most helpful in the definition of problems and RTOP programs.

A presentation to forty (40) members of the Tool and Die Institute by R. Levi outlined the purpose and goals of the MATEam. Related technology transfers were highlighted as part of the presentation.

FUTURE PLANS

Presentations and Press Releases

The Laser Wire Insulation Stripping System Demonstration at Rockwell International, November 17, was very successful. The published announcement related to the demonstration produced a large amount of inquiries. The demonstration itself was attended by representatives from 18 companies. It appears that a direct technology transfer and an RTOP program may result thanks to the demonstration.

During the reporting period a demonstration of the Weld Skate was conducted at the Marshall Space Flight Center. Representatives from the automotive, welding equipment and off-the-road equipment builders attended. It was unanimously agreed that the weld skate contained unique capabilities not available in presently available equipment. The final day for proposals has been set at November 30, 1978.

The press releases used to announce the equipment demonstrations are included in enclosures (4) and (5). The releases in addition to the MATEam article, enclosure (6) published in the Modern Machine Shop Magazine have produced numerous enquiries and companies interested in participating in the program.

Articles pertaining to the MATEam are still planned to appear in the American Society for Metals periodical, ASM News, and the Fabricating Manufacturers Association monthly (The Fabricator).

Industry Contacts

MATEam members will continue to maintain a good communication link with industry and will continue to contact companies on a daily basis during the next reporting period. Companies interested in the MATEam and which are considered to maintain a key position in their industry will be visited for on-site presentations and problem discussions.

Definition of Problems and RTOP Activities

Problem/opportunity statements will be consistently added to the listing to maintain an active range of 120-150 statements.

In the identification of candidate RTOP programs, strong emphasis will continue to be placed on determining the level of common interest the problem has with other federal agencies. In candidate RTOP programs in which other federal agency interest is strong, the agency will be evaluated as a co-funding source for the RTOP. Ideally, a MATEam goal will be to aid in identifying co-funding sources in the form of federal agencies and industrial organizations similar to MAT-131 which involves the Maritime Administration and Unimation, Inc.

The MATEam will continue to screen the manufacturing development programs of the Department of Defense, Maritime Administration, National Bureau of Standards and other federal agencies to identify manufacturing problem areas of common interest. In addition, MATEam will continue to pursue a system by which team members can evaluate Tech Brief magazine reader inquiries that pertain to manufacturing applications. MATEam analysts will contact readers who have shown an interest in NASA manufacturing technology.

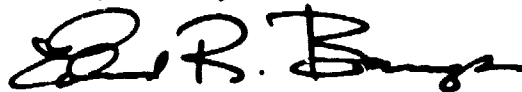
Problem Assessment and Solution Implementation

Program activities will continue to concentrate in the next quarter on RTOP programs related to welding equipment, fracture toughness test systems, the laser wire insulation stripper, and those technologies listed on enclosure (7). The addition of new, high impact problem/opportunity statements in addition to the assessment of existing problem statements will continue to be an area of high priority.

SUMMARY

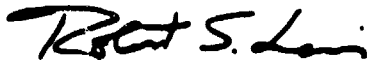
The MATEam continues to gain experience in contacts with Field Centers and industry pertaining to manufacturing technology transfer. The program continues to be of great interest to all involved. Knowledge of the MATEam and its objectives continues to grow. Therefore, we are looking forward to developing an increased amount of RTOP programs and an increased rate of technology transfers.

Respectfully submitted,



Edmund R. Bangs
Director
Manufacturing Applications Team

APPROVED:



Robert S. Levi
Manager
Technology Transfer and
Market Research Research

ERB:ds

NEW TECHNOLOGY EVALUATION AND
MARKET STUDY ACTIVITIES
MATEAM PROBLEM/OPPORTUNITY STATEMENTS

NEW TECHNOLOGY EVALUATION

<u>MAT NO.</u>	<u>TITLE</u>	<u>EVALUATION</u>
82	Automatic Laser Inspection of Printed Circuit Boards	High Technical Feasibility - Minimal Development Required to Produce Basic Production Prototype - Operational Testing Required
54	Non-Destructive Testing of Spot Welds	A (3) Component System: (a) Ultrasonic Hand Tool, (b) Ultrasonic scanner (c) Linear Voltage Displacement Transducer-Based Welder. Technically Feasible - Requires R & D and Market Research
16	The Concentration of Waste Heat Recovered Stack Gas and/or Waste Water	Technically Feasible - Requires Considerable R & D Before Prototype Can Be Field Tested
105	In Process Technique For Balancing Drive Shafts	Technically Feasible - On Site Prototype Testing Required
71	Computer Aided Design of Sand Casting Molds	Technically Feasible - Extensive Software Modification Required

MARKET STUDY ACTIVITIES

<u>MAT NO.</u>	<u>TITLE</u>	<u>PROJECT</u>	<u>COMPLETION DATE</u>
19	Power Factor Control System for AC Induction Motors	H6046 C46	December 77
71	Computer Aided Design of Die-Casting Dies	H6046 C51	August 78
82	Automatic Laser Inspection of PCB	H6046 C51	August 78
87	Low-Intensity Portable X-Ray Device	H6046 H39	January 78
105	In Process Technique for Balancing Drive Shafts	H6046 C51	October 78

SUMMARY OF MATEAM ACTIVITIES

<u>Activity</u>	<u>1977</u>	<u>1st Qtr. 1978</u>	<u>2nd Qtr. 1978</u>	<u>3rd Qtr. 1978</u>	<u>Program To Date</u>
Industry Presentations	14	9	3	2	28
Company Visits	31	4	1	7	43
Other Contacts (Phone, Mail, etc.)	467	78	46	82	673
Problems Identified	150	40	9	15	214
Problem Statements Prepared	150	30	0	22	202
1st Screening Completed	140	10	17	20	187
(Problems Failed 1st Screening)	(19)	(0)	(1)	(1)	(21)
NASA Technology Identified	24	10	17	5	56
(Problems Failed 2nd Screening)	(28)	(17)	(1)	(21)	(67)
Solutions Assessed	8	16	14	9	47
(Solutions Failed 3rd Screening)	(3)	(3)	(3)	(5)	(14)
Solution Strategies Developed	4	1	11	5	21
(Solutions Failed 4th Screening)	0	0	0	0	0
Applications Projects Started					
(a) RTOP Programs	0	0	0	2	2
(b) Industry Fund. ' Programs	0	1	0	0	1
(c) RFP Programs	0	0	1	1	2
Applications Projects Completed	0	(1)	0	0	(1)
Implementations Completed	0	1	1	4	6
Results Assessed	0	0	0	0	0

Enclosure 2

MATEAM PRESENTATIONS

February 21, 1978	International Harvester Company Manufacturing Process Development Group Hinsdale, IL.
March 21, 1978	American Welding Society (Chapter) Hartford, CT Audience-Aircraft Engine and Shipbuilding
March 24, 1978	Copper Development Association New York City, NY.
March 28, 1978	Wilson Greatbach LTD. Leading Micro-Battery Manufacturer Clarence, NY
April 17, 1978	International Lead-Zinc Research Organization New York City, NY.
April 18, 1978	Caterpillar Tractor Company East Peoria, IL.
April 26, 1978	American Society for Metals Metals Park, Ohio
April 27, 1978	Fifteenth Space Congress (NASA) Cocoa Beach, FL.
May 2, 1978	Raytheon Company Waltham, MA.
June 14, 1978	Machine Tool Forum Pittsburgh, PA.
June 28, 1978	Maritime Administration (REAPS) Shipbuilding Conf. St. Louis, MO.
October 1, 1978	American Society for Non-Destructive Testing Chicago, IL.
October 17, 1978	Marine Transport Industry Conference Williamsburg, VA
October 18, 1978	AARADCOM, Picatinny Arsenal Dover, New Jersey
*November 13, 1978	MTAG Meeting, Dept. of Defense San Diego, Calif.
*November 29, 1978	Tool and Die Institute Chicago, Illinois

*Future

Enclosure 3

R

IIT Research Institute
10 West 35 Street, Chicago, Illinois 60616
312/567 4000

PRESS RELEASE

Paula C. Norton
Manager, Public Relations
Ext. 4025

September 29, 1978

FOR IMMEDIATE RELEASE:

**NEW LASER WIRE INSULATION STRIPPING SYSTEM TO BE DEMONSTRATED
AT ROCKWELL INTERNATIONAL FACILITY**

CHICAGO--The NASA/IITRI Manufacturing Applications Team will conduct a demonstration of a new laser wire insulation stripping system to potential marketing and industry users at the Rockwell International facility at Downey, California. The demonstration is tentatively scheduled for the week of November 13. The system is capable of automatically stripping insulation from wire and cabling without damage to the wire. The system is being made available to industry through the IITRI Manufacturing Application Team as part of the transfer of aerospace technology to non-aerospace industrial applications. Those interested in attending the demonstration may do so by contacting Mr. E. R. Bangs, MATEam Director at IIT Research Institute, 10 West 35th Street, Chicago, IL 60616, (312)567-4191.

END

ENCLOSURE 4



IIT Research Institute
10 West 35 Street Chicago, Illinois 60616
312/567-4000

PRESS RELEASE

Paula C. Norton
Manager, Public Relations
Ext. 4025

September 29, 1978

FOR IMMEDIATE RELEASE:

NEW GENERATION COMPUTERIZED WELDING PROCESS TRACKING SYSTEM
DEVELOPED AT NASA FIELD CENTER

CHICAGO--A weld joint tracking system called, "The Weld Skate" has been developed at the NASA, Marshall Space Flight Center, Huntsville, Alabama. The device employs a real time system of integrated computer programs that regulate welding torch speed, angle, and location of the torch to the longitudinal axis of the weld joint when welding joints with irregular longitudinal axis. An operational system has been demonstrated to representatives of non-aerospace industry including GMC Technical Center, Caterpillar Tractor, Hobart, Merrick Engineering and Arcair.

The system now available to industry through the NASA/IITRI Manufacturing Applications Team is part of the overall transfer of aerospace technology to non-aerospace industry applications. Information on future equipment demonstrations and other technology may be obtained by contacting Mr. E. R. Bangs, MATEam Director, IIT Research Institute, 10 West 35th Street, Chicago, IL 60616 (312) 567-4191.

END

NASA Helps Solve Manufacturing Problems

The nation's investment in aerospace research is being returned by fostering wide implementation and use of NASA technology and expertise.

By EDMUND R. BANGS, Director—NASA Manufacturing Technology
IIT Research Institute
Chicago, Illinois

The objective of the manufacturing applications team (MATeam) is to successfully use aerospace technology to solve key problems in the manufacturing sector of the economy. The function of the team in accomplishing this objective is to provide an important intermediary role between technology sources and technology users in order to: improve the communication process; assist in the movement of new technology across organizational and disciplinary boundaries; and shorten the time between technological development and its broad and effective implementation.

NASA's decision to sponsor an applications team to effect technology transfer in manufacturing was both timely and appropriate. The United States, while still ahead of other industrialized nations in terms of overall manufacturing capabilities, productivity and state of technology, is finding its leadership position diminishing. The problem is becoming increasingly severe because of

the continual rise in the cost of energy, raw material and labor and the need to maintain our competitive position in the world market. Clearly, a way to combat this growing national problem and maintain our competitive advantage is to capitalize upon and speed up adaptation of new manufacturing technologies and equipment into the industrial sector. The appropriateness of NASA's decision is underscored by the fact that the areas of science and technology in which they have been actively advancing the state-of-the-art correspond closely to those needed by the industrial sector of the economy to improve manufacturing productivity.

Achieving significant technology transfer, widespread implementation, and usage of new products and processes do not occur quickly. To bring about successful technology transfer, industry problem areas or market needs must be matched with solutions that are both technically sound and economically feasible. This matching of needs with solu-



“...capitalize upon and speed up adaption of new manufacturing technologies and equipment into the industrial sector.”

tions does not, however, guarantee technology transfer; it is also necessary to establish effective means for commercializing the new product or process. Thus, the MATeam's task is somewhat analogous to that of identifying and implementing new business opportunities, and carries with it the many pitfalls normally associated with new venture development groups.

The approach is structured to insure that the team's efforts are focused on bringing about successful

technology transfer and avoiding the common pitfalls.

Effective communication channels among the team, industry associations, individual companies, NASA personnel and other government agencies are necessary to coordinate the team's efforts throughout all phases of the technology transfer process, from identification of technology opportunities to commercialization and implementation of new processes and equipment. The MATeam provides this interaction through numerous presentations to industry groups, visits to companies for in-plant discussions of problems and potential solutions, and extensive consultation by phone and mail. To help foster this type of interaction, there is no fee charged to industry for the team's services.

As an added means of increasing the team's effectiveness, it is concentrating on four target industries. In this way, the team can develop a close working relationship with the target industries and not dilute its efforts by trying to cover all industry types. This does not mean, however, that the team has not or will not work with companies outside the target categories if it appears that meaningful technology transfer can be achieved. The four target industries are:

- Machine tool builders
- Light fabrication and assembly
- Heavy equipment manufacturers
- Electronics assembly

There are two basic approaches that can be used to effect technology transfer:

1. Use the technology available as a basis for initiating the transfer process and then seek out applications for that technology.

2. Begin the transfer process by identifying the technology needs of the target industry sector and then determine if relevant technology is available to satisfy those needs. The latter approach is the one used by the MATeam.

Starting the technology transfer process with identification of industry needs rather than the aerospace technology available provides several distinct advantages. First, it helps insure that the team is responsive to the needs of industry. Second, it provides a ready market for the aerospace technology if it can be found, thus helping to insure rapid commercialization and implementation. Additionally, by documenting the technology opportunities and circulating them to appropriate NASA personnel, the effectiveness of the search for relevant technology is increased and, in some cases, may even result in innovative solutions to problems. Last, starting with industry problems rather than the available technology helps insure that the team's efforts are spent on areas of greatest need and payback, and not in trying to bring about solutions for which there is no real problem.

Manufacturing problems, or technology opportunities, are identified by working with professional societies, industry associations, various government agencies and individual companies. Once identified, problems are documented in the form of



"To date, 150 manufacturing problems on technology opportunities have been identified and documented."

problem statements, which serve as a means of communicating information about the problem so that team members can:

- Seek out potential solutions
- Evaluate the likelihood of successfully solving a problem and implementing a solution, and
- Compare problems and concentrate on those which have the highest likelihood of solution and benefit.

In addition to its internal use, edited copies of the problem statements are circulated to technical personnel in the NASA field centers and

laboratories. This helps insure that every effort is made to identify appropriate technology if it exists. The problem statements are edited prior to circulation to NASA personnel to reserve the name of the problem originator and any information of a proprietary nature.

Problems which the MATeam will work on must meet three criteria:

1. The problem must be manufacturing related.
2. The problem must apply to more than one company.
3. Solutions to problems must be based on NASA technology.

The problem statements are screened at several stages during the technology transfer process. The questions asked during the screening are:

- Do satisfactory commercial solutions already exist for this problem?
- What is the likelihood of identifying relevant NASA technology?
- What is the magnitude of the benefits to be gained by solving the problem?
- Can the problem be solved technically?
- Can a solution be implemented?

The answers to these questions are used to select those problems which the MATeam can most effectively solve. In those instances where a problem statement does not pass the screening process, the problem originator is informed of the reason for the decision.

Those problem statements which survive the preliminary screening then enter the next phase of the technology transfer process: iden-

tification of relevant NASA technology which could provide wholly or in part, a solution. This is accomplished through data and literature searches utilizing NASA's Scientific and Technical Information Facility, annual STAR indices, review of NASA Tech Briefs and by contacting individual NASA personnel with the necessary expertise for further discussions of the technology involved.

If the solution still appears valid after this assessment, the team then develops an implementation strategy to bring about commercialization. Such factors as applications engineering and implementation costs and the proper time phasing of the implementation are taken into consideration when developing the implementation strategies. Inputs from the problem originator and NASA personnel are solicited in devising these strategies. The particular implementation strategy that is developed will depend on the individual case in point, but in general, the strategy will be one of the following types:

- Direct transfer of the solution information and immediate implementation by the user.

- Applications engineering followed by test and implementation totally funded by the user or someone in a position to commercialize the process or product.

- Applications engineering jointly funded by the user and NASA with subsequent test and implementation by the user.

Once an implementation strategy

is agreed upon among the MATEam, NASA, the problem originator and a commercializer, implementation is initiated. It should be pointed out that successful technology transfer and implementation takes varying amounts of time to come to fruition, depending on the specific case. Some occur rapidly, while others require more time because of applications engineering and the type of industry and technology involved.

To date, 150 manufacturing problems on technology opportunities have been identified and documented. Thirteen of these problems have been screened while twenty potential technology transfers have been identified.

Most notable of the potential transfers include: An A-C Motor Power Factor Control that reduces the energy required to operate small motors; a Computerized Tracking and Torch Manipulation Welding

System (Weld Skate); Computer Aided Design of Sand Casting Molds; Automatic Laser Inspection of Printed Circuit Boards; and Tool Wear Sensing Using Vibrational Analysis. Although none of the technology transfers has been completed (for example, commercialized and implemented), several are entering the applications engineering phase and should reach completion during the next year or two.

In summary, the MATEam has been well received by the industry. Strong communications channels have been established among the team, NASA, individual companies, industry associations and other government agencies.

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ABOUT THE AUTHOR

Edmund R. Bangs received his BS in physical metallurgy in 1959 from Bradley University. He has had extensive experience in metals joining, nuclear welding, heat treating, plasma coating and high temperature brazing. Mr. Bangs joined IIT Research Institute in 1973 and became manager of the metals joining group. He is presently director of the NASA/IITRI Applications Team, which is devoted to solving industrial management problems using aerospace technology. Mr. Bangs has written several articles and has lectured internationally on the subjects of welding, soldering, pacemaker materials, and high temperature brazing. He is a member of the American Welding Society, American Society for Metals and the Welding Research Council.

NASA/MATEAM POTENTIAL RTOP PROGRAMS

<u>MAT NO.</u>	<u>TITLE</u>	<u>TECH CENTER</u>	<u>USER</u>	<u>POTENTIAL MARKETING SOURCE</u>
15	WASTE HEAT RECOVERED FROM STACK GAS OR WASTE WATER	J. P. L.	BURLINGTON INDUS. STEVENS FABRIC	THERMO KING TRANE
28	TESTING BEARINGS WHILE IN USE	JOHNSON	PRATT & WHITNEY ALLIS CHALMERS	J. R. & D MECHANALYSIS
54	NON-DESTRUCTIVE TESTING SPOT WELDS	MSFC	SHEET METAL FAB. INDUS.	KRAUTKRAMER BRANSON
55	NON-CONTACTING 3-D INSPECTION PROBE	LANGLEY	SCIENTIFIC PRODUCTS	GAERTNER SCIENTIFIC
71	COMPUTER AIDED DESIGN OF SAND CASTING MOLDS	JOHNSON (COSMIC)	FOUNDRY INDUSTRY	COSMIC COMPUTER CORPORATIONS
74	MEASURING CONFORMAL COATINGS FOR PRINTED CIRCUIT BOARDS	LEWIS	ELECTRONICS INDUSTRY	AUTOMATION INDUSTRIES UNION CARBIDE
82	AUTOMATIC LASER INSPECTION OF PRINTED CIRCUIT BOARDS	MSFC	ELECTRONICS INDUSTRY	EVERETT/CHARLES AMBRIT
87	LOW INTENSITY PORTABLE X-RAY DEVICE	GODDARD	AIRCRAFT INDUSTRY MEDICAL INDUSTRY	NI-TEC PICKER X-RAY
105	IN PROCESS TECHNIQUE FOR LASER BALANCING DRIVE SHAFTS	LEWIS	ENGINE INDUSTRY TURBINE INDUSTRY	MECH. TECH., INC.
131	RELIABLE, ECONOMICAL, FAST MANIPULATOR ARM (ADAMS)	MSFC	SHIPBUILDING OIL DRILLING	UNIMATION INC. VIM SYSTEMS CINCINNATI MILICRON

NASA/MATEAM POTENTIAL RTOP PROGRAMS (continued)

<u>NAT NO.</u>	<u>TITLE</u>	<u>TECH CENTER</u>	<u>USER</u>	<u>POTENTIAL MARKETING SOURCE</u>
167	RECYCLING OF PAINTING WASH WATER	MSFC	TEXTILE INDUS. METAL FINISHING	OSMONICS ABCOR
168	ORBITAL TUBE FLARING DEVICE	MSFC	PNEUMATIC AND HYDRAULIC SYSTEMS MANUFACTURER'S	GROTHES EMERSON
175	LASER WIRE STRIPPING	JOHNSON	BELDEN CABLE	RAYTHEON MARTIN MARIETTA